REMARKS

The above amendments to the above-captioned application along with the following remarks are being submitted as a full and complete response to the Office Action dated April 4, 2005. In view of the above amendments and the following remarks, the Examiner is respectfully requested to give due reconsideration to this application, to indicate the allowability of the claims, and to pass this case to issue.

Status of the Claims

As outlined above, claims 8 and 10-13 are being amended to correct formal errors and to more particularly point out and distinctly claim the subject invention. Applicant hereby submits that no new matter is being introduced into the application through the submission of this response.

Formal Objections or Rejections

Claims 8 and 10-13 were objected to for various informalities for which the Examiner provided suggested changes to overcome his objection. As outlined above, the claims are being amended in accordance with the Examiner's suggestions.

Prior Art Rejections

The Examiner rejected claim 1 under 35 U.S.C. § 102(b) as being anticipated by the Japanese Reference No. H11-087831 to Iwamoto.

The Examiner rejected claims 2-4, 6-8 and 18 under 35 U.S.C. § 103(a) as being unpatentable over Iwamoto '831 in view the Applied Physics Letters Vol. 67, pages 1048-50 to Issiki. Also, the Examiner also rejected claim 5 under 35 U.S.C. § 103(a) as being unpatentable over US Patent No. 5,400,308 to Sugaya in view of Iwamoto '831. Further, claims 11, 14, 15, 16 and 17 was rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of Iwamoto '831 and Issiki, and in view of the Applied Physics Letters Vol. 67, pages 524-26 to Usami, US Patent No. 5,365,535 to Yamaguchi et al., US Patent No. 6,394,665 to Hayashi et al., US Patent No. 6,741,538 to Momoo et al., or Japanese Reference No. H05-182229 to Misako, respectively. Applicants have carefully reviewed the above-noted references and hereby respectfully traverse.

The present invention as recited in claim 1 is directed to an optical head characterized by a light source formed of <u>an indirect semiconductor laser</u>, a lens for focusing a light beam

from the light source onto a medium, and a detector for detecting a reflected light beam from the medium.

As recited in claim 4, the present invention is directed to an optical head characterized by a semi-conductor laser having an active layer made of <u>an indirect semiconductor mixed crystal material</u>, and a detector for detecting a reflected light beam from a medium.

Further, as recited in claim 5, the present invention is directed to an optical head characterized by a recording laser, and a reproducing laser provided independent from the recording laser, the reproducing laser being <u>an indirect semiconductor laser</u>.

Among its main features, the present invention is directed to an indirect gap semiconductor structure, not a direct gap semiconductor structure, as clearly disclosed and claimed in this application. Applicants will respectfully point out that the cited references of Usami, Yamaguchi '535, and Iwamoto '831 all do not disclose any indirect gap semiconductors. Rather, all these references are directed to conventional direct gap semiconductors.

Specifically with respect to Iwamoto '831, this reference not only discloses a typical direct gap semiconductor but also shows a configuration that would not use an indirect gap semiconductor in an active layer. To explain this distinction between the present invention and the disclosure of Iwamoto '831, we will refer to the following figure which shows how the band-gap (Emission Wavelength, direct gap/indirect gap) of an InA1Ga semiconductor is changed as the composition of In, Al and Ga is changed, as follows:

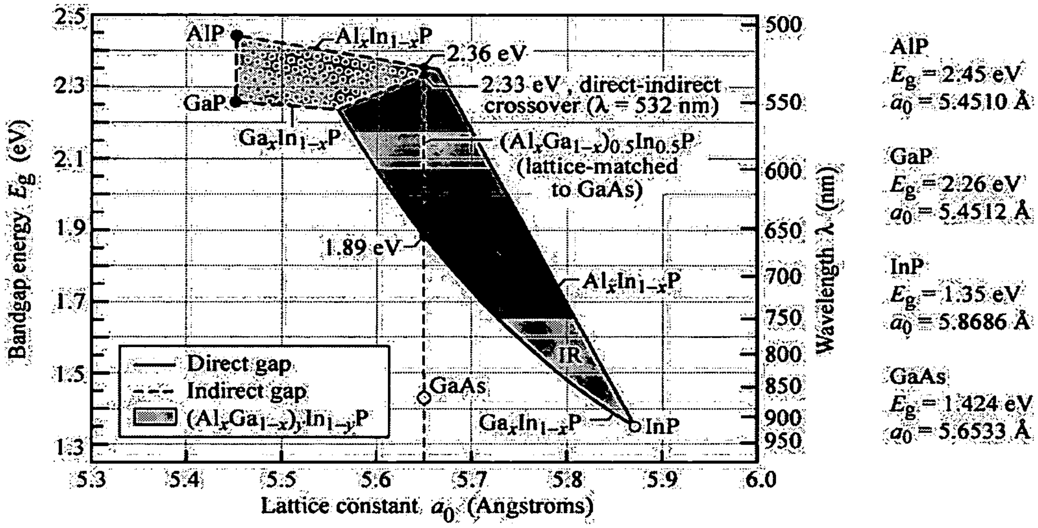

Fig. 12.9. Bandgap energy and corresponding wavelength versus lattice constant of $(Al_xGa_{1-x})_yIn_{1-y}P$ at 300 K. The dashed vertical line shows $(Al_xGa_{1-x})_{0.5}In_{0.5}P$ lattice matched to GaAs (adopted from Chen *et al.*, 1997).

In the above figure, the zone surrounded by the chain line, that is, the half-tone dot meshing zone exhibits the one in which an indirect semiconductor is obtained, and a zone surrounded by the solid line exhibits the one in which a direct semiconductor is obtained.

Iwamoto '831 discloses $(Al_{x1}Ga_{1-x1})_{1-y1}In_{y1}P$ as a clad layer which is lattice-matched on GaAs substrate with a distortion factor of 1.5 x 10^{-3} to 3 x 10^{-3} and a $Ga_{1-z}In_zP$ as an active layer.

Applicants will note that the A1GaP group according to the present invention, though apparently having a characteristic similar to that disclosed by Iwamoto '831, the ALGaP group (AIP ~ A1GaP ~ Gap)) of the present invention exhibits a perfect indirect gap semiconductor over an entire composition zone (surrounded by the red line). In contrast, an InA1GaP group formed on a GaAs substrate as disclosed in Iwamoto '831 exhibits a direct gap semiconductor over a substantially entire zone (surrounded by the green line).

According to the precise computation:

$\Delta a/a$ = (a2-al)/al (GaAs substrate)

5.6533 x (3 x 10^{-3}) + 5.6533 = 5.6703 (In composition = 5.525)

5.6533 x (-1.5 x 10^{-3}) + 5.6448 (In composition = 0.464)

the InAlGap lattice-matched on the BaAs substrate with a distortion factor of 1.5 x 10^{-3} to 3 x 10^{-3} as disclosed in Iwamoto '831 has a lattice constant in a range from 5.6703 ~ 5.6448 angstroms (a zone surrounded by the green line), corresponding to the In composition range 0.46 < z,yl < 0.53. This zone is in the vicinity of the lattice constant (5.6533 angstroms: dotted line) of GaAs, and accordingly, this zone exhibits a direct gap semiconductor (except Al composition > 0.85), except only a small top part of this zone. Further, a light emitting layer (active layer) as disclosed in Iwamoto '831 is an InGaP layer (excluding Al) that corresponds to the lower end part (surrounded by the blue line) of the zone surrounded by the green line. Thus, Iwamoto '831 only discloses a typical direct gap semiconductor laser having an AlGaInP laser structure incorporating an active layer formed of a direct gap semiconductor. Iwamoto '831 cannot embody an indirect gap semiconductor by definition.

Accordingly, Applicants will point out that any conventional laser using AlGaInP having Al composition less than 0.85 is a direct gap semiconductor laser. For example, AlGaInP disclosed in Sugawara '889 (cited but not applied) has In ~ 0.5 and Al $\leqq$ 0.7, and thus accordingly, it is a direct gap semiconductor (Refer to Figs. 15, 27, 28), having an active layer and a clad layer which are both also of direct gap type. In addition, the AlGaInP group has often been used for yellow ~ red lasers with the use of a direct gap zone (In ~ 0.5). Even with the use of conventional technology, a semiconductor laser having a light emission with a high degree of efficiency can be produced.

On the other hand, the AlGaP group as in the present invention is a completely indirect gap semiconductor in which the coupling of electrons and holes has been difficult, which has been highly sensitive to crystal defects, and which has required the use of technology wherein a crystal with high purity and high quality can be produced. Thus, no indirect gap semiconductor capable of laser oscillation has been available until now.

In view of all the above discussion, Applicants will contend that Iwamoto '831 can neither anticipate nor render obvious the present invention as claimed because this reference is specifically directed to a structure inconsistent with the specific characteristics recited in and required by the claims of the present invention. In particular, as discussed above and as disclosed in the specification (for example, page 5, line 20 to page 11, line 6), there are notable differences between the structure and operation of the present invention which is based on indirect gap semiconductors, and those of direct gap semiconductors upon which Iwamoto '831 is based. It is well established that a reference that teaches a structure and/or

operation that contradicts those of the claimed invention cannot be properly cited as prior art against the claimed invention. Therefore, the present invention is distinguishable and thereby allowable over Iwamoto '831.

Regarding the remaining references cited against the present invention, since Iwamoto '831 is hereby removed from being prior art against the present invention, none of the remaining cited references, either by themselves or in combination with one another, provides any disclosure, teaching or suggestion for any structure that embodies all the features of the claimed invention. For example, as noted by the Examiner in the Office Action, Sugaya '308 by itself does not show a reproducing laser made from an indirect gap semiconductor laser. Applicants will submit that, absent such a teaching, one of skill in the art would not appreciate nor find obvious the features and advantages of an optical head having decreased noise with the use of broad light emission as achieved by the present invention in view of Sugaya '308.

All the remaining secondary references are merely cited for showing specific features of the present invention as claimed. As noted above, without the primary reference of Iwamoto '831, none of these references provide any disclosure, teaching or suggestion that makes up for the deficiencies in Iwamoto '831 or for their own deficiencies. For example, Applied Physics Letters Vol. 67 (1995) is a past article which was written by one of the inventors in the present application and which discloses the evaluation results of photoluminescence in which electrons and holes are produced in a sample (crystal) by applying thereto an energy of a laser beam from an He-Cd laser (326 nm) so as to cause the sample to be luminous, instead of the provision of electrodes to the sample. The luminescence in the above-mentioned evaluation is not caused by simulated emission but by spontaneous emission. Further, due to no provision of electrodes, the sample is not a semiconductor laser element. Thus, this article does not disclose any application to lasers, much less indirect gap semiconductor lasers, although it discusses luminescence with high efficiency.

Further, Momoo '538 merely discloses a band-pass filter. Applicants will point out that a direct gap semiconductor laser in general already has a sharp oscillation spectrum, and accordingly, no provision of a band-pass filter is particularly required in a laser used in an optical head. There would be no motivation to combine this reference with any other reference cited.

Even more, Misako '229 simply discloses the provision of a cooling mechanism for maintaining a wave-length of a light beam to be constant. In the present invention, a cooling mechanism is used for narrowing (sharpening) a broad peak (spectrum width), which is peculiar to an optical head using an indirect gap semiconductor laser.

As shown above, there exist no references of record that, either by themselves or in combination, can anticipate or render obvious each and every feature of the present invention as claimed. Instead, the present invention as a whole is distinguishable and thereby allowable over the prior art of record.

Conclusion

In view of all the above, Applicant respectfully submits that certain clear and distinct differences as discussed exist between the present invention as now claimed and the prior art references upon which the rejections in the Office Action rely. These differences are more than sufficient that the present invention as now claimed would not have been anticipated nor rendered obvious given the prior art. Rather, the present invention as a whole is distinguishable, and thereby allowable over the prior art.

Favorable reconsideration of this application as amended is respectfully solicited. Should there be any outstanding issues requiring discussion that would further the prosecution and allowance of the above-captioned application, the Examiner is invited to contact the Applicant's undersigned representative at the address and phone number indicated below.

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